Perennial ryegrass

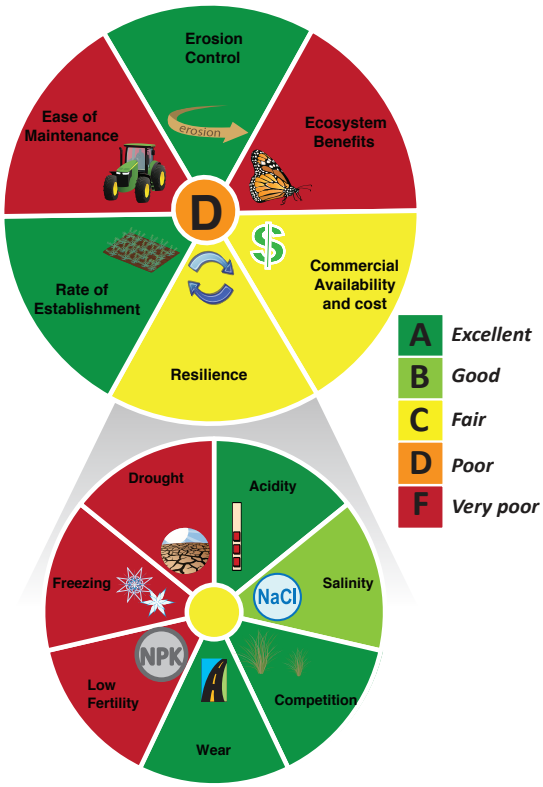
Lolium perenne

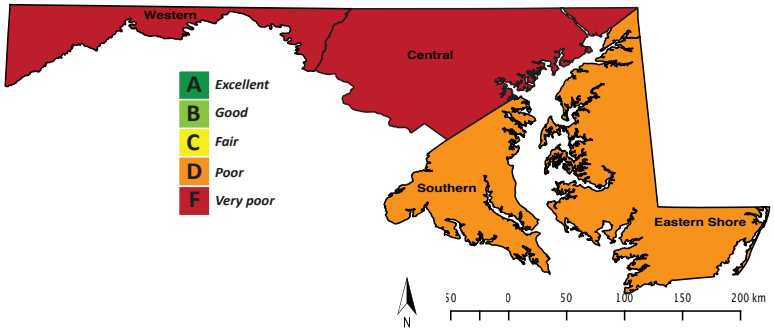
Owing to its high commercial availability, fast establishment rate, and deep and fibrous root system that reduces erosion, perennial ryegrass is used extensively as a nurse grass in establishing grass mixtures. It is therefore often incorporated into roadside grass mixtures. Despite these excellent attributes, perennial ryegrass receives one of the poorest ratings (Poor = D) as a turfgrass for roadside management owing to a variety of management concerns:

Perennial ryegrass is exceptionally poor in providing ecosystem benefits. The species is non-native and non-persistent with some cultivars exhibiting high leaching potential. Perennial ryegrass is also an aggressive competitor and hence a biodiversity reducer.

Mowing requirements for perennial ryegrass can be substantial. The species requires fertilization and irrigation to maintain turf quality beyond the first year of growth.

Perennial ryegrass has very poor freezing and drought tolerances and requires fertile soils to persist. It is highly disease prone. Hence, resilience of perennial ryegrass along roadsides is only fair.





Perennial ryegrass is not recommended for use along roadsides in any part of Maryland owing to its sensitivity to freezing as well as drought.

Proven perennial ryegrass cultivars for Maryland in 2016 include Apple GL, Apple SGL, ASP6004, Banfield, Charismatic II GLSR, Fiesta 4, Grandslam GLD, Homerun, Line Drive GLS, Octane, Palmer V, Paragon GLR, Rio Vista, Soprano, Stellar GL, Stellar 3GL, and Uno. Updates to recommended cultivars in Maryland are published annual in the University of Maryland Turfgrass Technical Update TT77 (Maryland Turfgrass Council).

Biology: Perennial ryegrass is a short-lived noncreeping bunch-type grass native to temperate regions of Asia and North Africa (Beard 1973). It is adapted to cool moist climates with mild winters and cool moist summers. Thus, it does not persist if not subjected to extremes in temperatures (Beard 1973). It is used extensively for forage and turf purposes but also along roadsides and for general landscaping (Thorogood 2003).

Seeds per pound: 230,000 (USDA Fact Sheet)
Cost per pound: $1.85 per pound from Chesapeake Valley Seed
Cost per acre: $240.50 per acre
Suggested sowing rate: 130 pounds per acre (Turner *pers. communication*)
Sowing depth: ½ inch or less
Germination time: 5-10 days
Seeding timing: March through May or mid-August through early September (USDA Fact Sheet) with fall Seedings under irrigated conditions (USDA Plant Guide).
Length of growing season: May through June with a possible second growth season in the fall (USDA Plant Guide)
Leaf length: 2-6 inches
Height at seed head stage: 3.9-35.4 inches (Thorogood 2003)
Shade tolerance: adaptation to partial shading is good (Beard 1973)
Suggested mowing height: 1.5 to 2 inches is preferred.
Tolerance of wet conditions: tolerates extended periods of flooding (up to 25 days; Thorogood 2003) and wet soil conditions as long as drainage is adequate (Beard 1973).
Humidity tolerance: tolerant of humid climates.
Disease resistance: susceptible to *Pythium* blight, ruse, *Fusarium* patch, brown patch, red thread, stripe smut, *Typhula* blight and *Helminthosporium* (Beard 1973, Thorogood 2003, Brede 2000). Seeds and plants are infected by the endophytic fungus *Neotyphodium lolii*, which deters a range of insect pests (Thorogood 2003, Brede 2000).

Services:

Commercial availability and cost: Perennial and annual ryegrass seed is commercially available and affordable, even over large areas.


Rate of establishment: Perennial ryegrass, and its close relative Italian ryegrass (*Lolium multiflorum*) have a rapid germination rate, fast establishment rate (Beard 1973, Erdman and Harrison 1947, Brede 2000), and a fast growth rate (VanHuylenbroeck and VanBockstaele 1999) compared to other cool season grasses. Percent germination is high (85-95%; Wrochna et al. 2010), and establishment is quick even in low-input environments (McKernan et al. 2001, Watkins et al. 2010, Brown et al. 2011, Friell et al. 2012). The rapid establishment allows Perennial ryegrass to be used for turf repairs by managers, even under adverse conditions (Brede 2000).


Ease of maintenance: Perennial ryegrass is a relatively short statured plant growing between 10 and 90 cm tall (Thorogood 2003). Perennial ryegrass cultivar 'Fiesta' had a low stature in a study comparing 25 turfgrass cultivars and species (McKernan et al. 2001) suggesting that cultivars could be selected that would decrease the need for mowing. A study comparing natural

populations of perennial ryegrass to forage-type cultivars and turf-type cultivars (Sampoux et al. 2013) observed that breeding has decreased the turf height increase rate. Perennial ryegrass produced better quality turf at reduced irrigation rates and recovered from stress better than tall fescue (Barnes et al. 2014). It produced good turf quality in the first year of a low-input fairway study in Minnesota (Watkins et al. 2010); however, quality could not be maintained beyond the first year and especially when subjected to traffic in the second year. Thus, perennial ryegrass requires continued fertilizer applications and irrigation to maintain a presence in turf beyond the first year.

Erosion control: Perennial ryegrass effectively controls erosion by germinating quickly (Thorogood 2001, Brown et al. 2011) and thereby establishing ground cover quickly. The roots are fibrous but the root system is annual (Beard 1973) and therefore not suited for erosion control when grown alone. Brown et al. (2010) observed the root system of perennial ryegrass to relatively evenly distributed in the soil column with roots penetrating the soil column to the lowest depth measured at 76 cm and a mean rooting depth of 75 cm. This root system is probably explains why perennial ryegrass turf that was trafficked was able to maintain water retention as high as tall fescue but significantly higher than fine fescue turf (Glab and Szewcyk 2014). Thus, perennial ryegrass can increase infiltration capacity of trafficked soils which enhances erosion control by decreasing overland flow.


Ecosystem benefits: Perennial ryegrass is non-native and non-persistent and therefore does not provide significant and sustainable ecosystem benefits. In a study examining soil nitrate levels associated with perennial ryegrass, Kentucky bluegrass, and tall fescue, Liu et al. (1997) measured soil nitrate levels to be lower than Kentucky bluegrass but higher than tall fescue. A 5 to 10-fold range in nitrate concentrations was observed among cultivars with none exceeding drinking water standards. Nitrate loss by leaching also differed among cultivars with cultivars 'J208', 'Manhattan', and 'J207' exhibiting high leaching potential and cultivar 'Linn' showing the least leaching potential.


Resilience:


Drought: Perennial ryegrass has little tolerance to drought (Carroll 1943, Beard 1973, McKernan et al. 2001, Thorogood 2003) and therefore tends to be a short-lived species along no-input roadsides. It has a high (8.5-10 mm/day) evapotranspiration rate (Beard and Kim 1989) and therefore requires more water than fine fescues and warm season grasses. Perennial ryegrass declined rapidly when soil water potential reached -50 to -80 kPa as opposed to hard and chewings fescue, which demonstrated a greater ability to thrive under limited soil moisture (Aronson et al. 1987). In contrast, killing time was long and electrolyte leakage relatively low in perennial ryegrass compared to 5 other turfgrass species (Wallner et al. 1982) suggesting that other traits are responsible for the low drought tolerance in perennial ryegrass. Perennial ryegrass exhibited higher tolerance to drought than Kentucky bluegrass but lower tolerance than creeping bentgrass and tall fescue (Pessarakli and Kopec 2008, Brede 2000). Perennial ryegrass was more heat tolerant than its close cousin annual ryegrass (Yang et al. 2014). Perennial ryegrass can go dormant if drought persists in the summer (Brede 2000). Cultivars of Perennial ryegrass that are considered to be most drought resistant include 'Passport', 'Affinity', 'Calypso II', and 'Edge' (McCann and Huang 2008). Yet, NTEP trials have observed no significant improvement in drought tolerance among new cultivars compared to old standards (Thorogood 2003).

Low fertility: Perennial ryegrass requires medium to high soil fertility (Beard 1973, Thorogood 2003). Perennial ryegrass cultivar persistence was low in low fertility environments (McKernan et al. 2001).

Freezing*:* Perennial ryegrass has poor low-temperature tolerance (Carroll 1943, Beard 1973, Stier and Fei 2001) and therefore suffers serious winter injury (Stier and Fei 2008, Friell et al. 2012). Its roadside performance in areas with cold winters is therefore poor (Brown and Gorres 2011, Friell et al. 2012), suggesting that its usefulness beyond serving as a cover crop is limited along roadsides (Brown and Gorres 2011, Friell et al. 2012). No improvements in winter hardiness have been achieved by breeders (Thorogood 2003). Perennial ryegrass can be considered a short-lived perennial because of its poor freezing tolerance, which leads to winterkill (Iraba et al 2013).

Salinity: Marcum (1999, 2008a), Beard (1973), and Marcar (1987) rate perennial and annual ryegrass as moderate in salinity tolerance at 4-8 dS/m with salt tolerance conferred through its ability to exclude Na+ (Krishnan 2010). Percent germination decreased from 95% to 85% at higher salinity levels and germination was delayed by up to 3 days. Root length and seedling growth also decreased at higher concentrations of deicers (Wrochna et al. 2010). Biomass yield decreased 5%, 17%, to 44% with salt additions of 5,000, 10,000, and 20,000 ppm respectively (Hughes et al. 1975). Dry matter yield of perennial ryegrass did not differ under salt and no-salt treatments but foliar injury was significant (Greub et al. 1985) with low percent green tissue (Friell et al. 2013). Experiments by Balterenas et al (2006) as well as Kazlauskiene and Brukstute (2105) found that Perennial ryegrass established and grew quickly but the above ground phytomass were reduced when compared to a control stand. Perennial ryegrass can exhibit salt tolerance as high as tall fescue (Wang et al. 2011, Zhang et al. 2013) and red fescue (Zhang et al. 2013) in germination trials. In a hydroponics system, perennial ryegrass exhibited higher tolerance to salinity than Kentucky bluegrass but lower tolerance than creeping bentgrass (Pessarakli and Kopec 2008). However, during vegetative growth, perennial ryegrass was only as salt tolerant as salt-sensitive Kentucky bluegrass (Wang et al. 2011), contradicting earlier observations (Harivandi et al. 1992, Marcum 2007). Similarly, perennial ryegrass was less salt tolerant than annual ryegrass during germination but more tolerant during vegetative growth (Marcar 1987). Different cultivars of perennial ryegrass showed a range of tolerances to salinities (Marcar 1987, Krishnan 2010) with higher salt tolerance linked to lower relative growth rate and competitive ability (Humphreys 1981). Large variations in salinity tolerance are observed in perennial ryegrass cultivars (Marcum 2007, 2008a, Rose-Fricker and Wipff 2001) with perennial ryegrass cultivars Brightstar SLT, PST-2SLW, B-2, Manhattan 3, PST-216, Catalina, and Fiesta III being the most salt tolerant (Rose-Fricker and Wipff 2001, Marcum 2008a, Krishnan 2010). Cultivars ‘Paragon’, ‘Divine’. And ‘Williamsburg’ were the most salt tolerant cultivar among 32 perennial ryegrass turf cultivars (Marcum and Pessarakli 2010) as assessed using leaf clipping dry weight, root weight, rooting depth, and percent green leaf canopy area relative to a control.

Acidity: Perennial ryegrass prefers neutral to slightly acidic soils with an optimim pH of 6.5 (Beard 1973), however alkaline soils to pH 8.4 are tolerated (Thorogood 2003). Liu et al. (2008) suggests that cultivars of perennial ryegrass differ in their resistance to aluminum and rank overall acid tolerance and aluminum resistance as medium.

Wear tolerance: Perennial ryegrass is highly tolerant of traffic (Beard 1973, Canaway 1981, Cockerham et al. 1990, Dunnet al. 1994, Thorogood 2003, Krishnan 2010). It was ranked highest in wear tolerance among 7 species (Glab et al. 2015). Perennial was highly wear tolerant the first year of establishment, but turf quality seriously declined in the second year of a low-input fairway study in Minnesota, which affected species tolerance to imposed traffic (Watkins et al. 2010). Brede (2000) found that Perennial ryegrass has limited ability to refill bare spots that resulted from wear. Improvement among cultivars in wear tolerance has been observed (Sampoux et al. 2013).

Competition: Perennial ryegrass should not compose more than 20-25% of the seed mixture on a seed number basis (Beard 1973) and should be kept to a minimum if used at all (Erdmann and Harrison 1947). Higher levels of perennial ryegrass in seed mixtures would lead to excessive competition. Ryegrass negatively affected the growth of Kentucky bluegrass, chewings fescue, and redtop bentgrass in polyculture owing to the initial rapid growth of ryegrass (Erdmann and Harrison 1947). Interseeding zoysia into existing perennial ryegrass resulted in only 2% zoysia cover after 120 days (Patton and Williams 2004b).

Mixes: Perennial ryegrass is often used as a nurse grass in seed mixtures (Erdmann and Harrison 1947, Meyer and Pederson 1999) when rapid establishment of turf and rapid soil stabilization is desired. In North America it is often mixed with Kentucky bluegrass for lawns and sports pitches and is seldom planted alone (Thorogood 2003). Blending perennial ryegrass with Kentucky bluegrass, tall fescue and fine fescues can lead to a nice mixture (Brede 2000). After a five-year experiment, Hunt and Dunn (1993) found that perennial ryegrass began to dominate swards where it was planted with tall fescue and Kentucky bluegrass after two years. Perennial ryegrass is used for winter overseeding of dormant grasses (Beard 1973, Thorogood 2003, Nelson et al. 2005, Richardson et al. 2007, Thoms et al. 2011, Trappe et al. 2012) to provide adequate winter color. In grassland settings, perennial ryegrass is frequently mixed with clover for better pasture yield (Elgersma and Hassink 1997, Eriksen et al 2014, Gibb et al 1989, Hay and Hunt 1989).

The use of perennial ryegrass should be avoided unless rapid establishment is essential for erosion control (Erdmann and Harrison 1947). Brede (2000) mentions that the explosive seed growth can overwhelm other species in a mixture and wipe them out. When added to a mixture of tall fescue and Kentucky bluegrass, Perennial ryegrass dominated the mixture regardless of manager intervention (Dunn et al 2002). By frequently overseeding Perennial ryegrass, Elford et al. (2008) hoped to suppress weeds in established grass swards on sports fields. They found that this provided adequate weed competition and should be considered part of a non-pesticide weed management program (Elford et al 2008).

Cultivars: A number of cultivars were developed in the United States in the 1960's including 'Linn', 'NK100', 'Manhattan', and 'Pennfire' (Thorogood 2003, Brede 2000). Bonos et al. 2004 used selection experiments to increase root mass by 130% in turf type and 367% in forage type perennial ryegrass.

Hybrids: Perennial ryegrass shows degrees of fertility with species of the genus *Festuca* and other genera (Thorogood 2003). The deep root system of fescue is a desirable trait to increase drought and heat resistance and has therefore been used to introgress increased drought tolerance into *Lolium* backgrounds (Barnes et al. 2014), producing the hybrid *Festulolium*.